

Photons and Dileptons at LHC

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Abstract. We discuss real and virtual photon sources in heavy ion collisions and present results for dilepton yields in Pb+Pb collisions at the LHC at intermediate and large transverse momentum p_T .

Electromagnetic radiation provides a valuable tool to understand the dynamics of heavy ion collisions. Due to their long mean free path real and virtual photons carry information from very early times and from deep inside the fireball. We discuss the sources of photons which will be important for the upcoming heavy ion experiments at LHC. We focus on intermediate and large transverse momenta p_T and masses M . We also present our numerical results for dilepton yields.

At asymptotically large p_T the most important source of real and virtual photons is the direct hard production in primary parton-parton collisions between the nuclei, via Compton scattering, annihilation, and the Drell-Yan processes. These photons do not carry any signature of the fireball. They are augmented by photons fragmenting from hard jets also created in primary parton-parton collisions. The emission of this vacuum bremsstrahlung is described by real and virtual photon fragmentation functions. Vacuum fragmentation is assumed to happen outside the fireball, so the jets are subject to the full energy loss in the medium. This contribution to the photon and dilepton yield is therefore depleted in heavy ion collisions analogous to the high- p_T hadron yield.

At intermediate scales jet-induced photons from the medium become important. It has been shown that high- p_T jets interacting with the medium can produce real and virtual photons by one of two processes: (i) by Compton scattering or annihilation with a thermal parton, leading to an effective conversion of the jet into a photon [1]; (ii) by medium induced Bremsstrahlung [2]. Jet-medium photons have a steeper spectrum than primary photons and carry information about the temperature of the medium. They are also sensitive to the partial energy loss that a jet suffers from its creation to the point of emission of the photon. At even lower p_T and M thermal radiation from the quark gluon plasma (and also the hadronic phase not considered here) has to be taken into account.

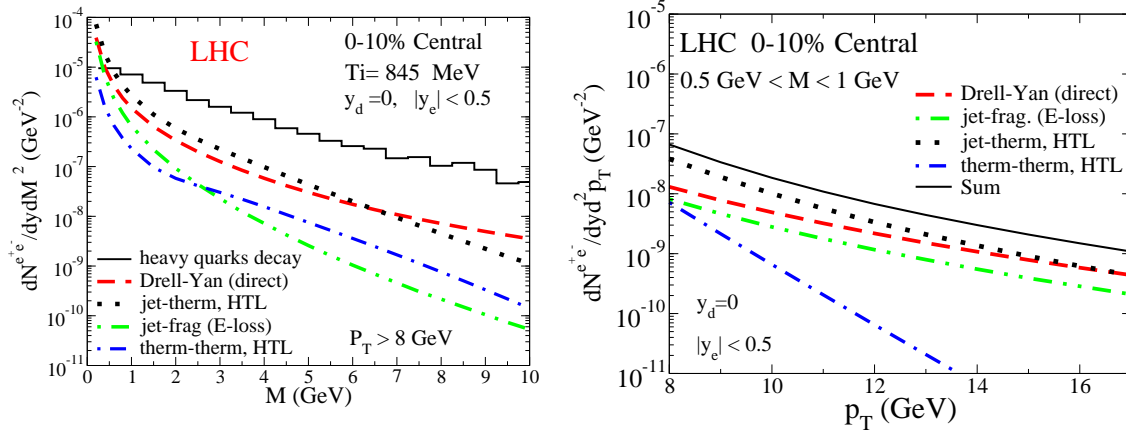


Figure 1. The yield of e^+e^- pairs in central Pb+Pb collisions at $\sqrt{s_{NN}} = 5.5$ TeV. *Left:* Mass spectrum $dN/(dy ddM^2)$ integrated over the transverse momentum p_T of the pair for $p_T > 8$ GeV/c. *Right:* Transverse momentum spectrum $dN/(dy dd^2 p_T)$ integrated over a mass range $0.5 \text{ GeV} < M < 1 \text{ GeV}$. Both panels show the case $y_d = 0$ for the pair rapidity y_d and a cut $|y_e| < 0.5$ for the single electron rapidity.

Figure 1 shows numerical evaluations of the different contributions discussed above to the e^+e^- transverse momentum and mass spectrum for central Pb+Pb collisions at LHC. We use next-to-leading order pQCD calculations for Drell Yan and a leading order calculation for jet production. Energy loss of jets is computed with the AMY formalism [3]. Jet-medium emission and thermal emission have been evaluated in the Hard Thermal Loop (HTL) resummation scheme. For the mass spectrum we also show the expected background from correlated heavy quark decays. The full calculation for dileptons with a more extended discussion is presented in [4]. Predictions for direct photon yields including jet-medium photons can be found in [3].

Dileptons from jet-medium interactions will be more important at LHC than at previous lower energy experiments. They will be as important or even exceeding the Drell-Yan yields at intermediate masses up to about 8 GeV. They offer a new way to access information about the temperature and the partonic nature of the fireball.

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